ACCESSION #: 9908050170

NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Quad Cities Unit 1 PAGE: 1 OF 5

DOCKET NUMBER: 05000254

TITLE: Reactor Scram due to Steam Intrusion into the Scram

Discharge Volume

EVENT DATE: 05/21/1999 LER #: 1999-002-01 REPORT DATE: 07/29/1999

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

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Manager, ext. 3100

COMPONENT FAILURE DESCRIPTION:

CAUSE: SYSTEM: COMPONENT: MANUFACTURER:

REPORTABLE EPIX:

SUPPLEMENTAL REPORT EXPECTED:

ABSTRACT:

On May 21, 1999, while at 100% power, Unit 1 scrammed from a Scram Discharge Volume (SDV) high level signal due to steam intrusion into the SDV. A Reactor Water Cleanup (RWCU) relief valve had lifted due to a pressure transient event in the system, discharging hot water and steam. The steam back-flowed into the SDV through common drain piping, and actuated the SDV high level scram signal. Following the scram, when

off-site power transferred from the Unit Auxiliary Transformer (T11) to the Reserve Auxiliary Transformer (T12), the Unit 1 Emergency Diesel Generator (EDG) started without loading to the emergency bus. The EDG was secured after it was verified that there was no loss of off-site power.

The root causes of the scram are that (1) given the current RWCU design, less than adequate procedural guidance was provided for RWCU system startup, and (2) there was steam actuation of the SDV level sensing devices. RWCU system startup procedures were changed, and the SDV level sensing devices will be reviewed for sensitivity adjustments. The scram event was not safety significant. The Reactor Protection System tripped as designed, and no water was introduced into the SDV until after the scram.

The root cause for the EDG auto-start is an inadequate design. The existing logic provides a momentary auto-start signal during 4KV Bus auto-transfer. Because the EDG conservatively auto-started and ran as designed, this event is not safety significant.

PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2511 MWt rated core thermal

power.

EVENT IDENTIFICATION:

Reactor Scram due to Steam Intrusion into the Scram Discharge Volume

A. CONDITIONS PRIOR TO EVENT:

Unit: 1 Event Date: May 21, 1999 Event Time: 2046 hours

Reactor Mode: 1 Mode Name: Power Operation Power Level: 100%

This report was initiated by Licensee Event Report 254/99-002

Power Operation (1) - Mode switch in the RUN position with average

reactor coolant temperature at any temperature.

B. DESCRIPTION OF EVENT:

On May 21, 1999, Unit 1 was at 100% power. At 1700 hours the Reactor

Water Cleanup (RWCU) [CE] system was shutdown and isolated in

accordance with procedure QCOP 1200-08, "RWCU System Shutdown," to support the performance of Instrument Maintenance surveillance procedure QCIS 1200-02, "RWCU Automatic Isolation Analog Trip System Calibration And Functional Test." At 1917 hours, QCIS 1200-02 was completed and operators began to place the RWCU system back in service in accordance with procedure QCOP 1200-11, "RWCU System Startup and Pump Operation." The Administrative Nuclear Station Operator (NSO) then opened RWCU pump suction valve 1-1201-80, and started the RWCU pump in accordance with the procedure. RWCU was back in service at 2035 hours.

At 2045 hours, 14 seconds, Unit 1 received annunciator alarm 901-5 D-1, "South Scram Discharge Volume Not Drained," and operators began responding in accordance with the annunciator response procedure. At 2046 hours, 02 seconds, the "Channel B Scram" and "Scram Discharge Volume High Level" alarms were received, and at 2046 hours, 42 seconds, a full scram was received.

When Unit 1 scrammed, the Main Generator [TB] tripped as designed, and off-site power from the Unit Auxiliary Transformer (T11) [EA] was transferred to the Reserve Auxiliary Transformer (T12) as expected.

At the time of the transfer of off-site power, the Unit 1 Emergency Diesel Generator (EDG) [EK] started, but did not close in to the emergency bus. The EDG was secured after it was verified that there was no loss of off-site power, in accordance with plant procedures.

Following the scram, Operations personnel reported seeing wisps of steam coming from drain funnels and the RWCU precoat tank. This steam indicated that the source of leakage had heated up the Reactor Building Equipment Drain Tank (RBEDT) [CC]. The SDV [JC] isolated automatically during the scram as designed. At this point, steam continued to come from the drain funnels. While systems were being restored after the scram, including opening of the SDV vent and drain valves, the SDV level instruments alarmed again and did not clear until the SDV drain valves were closed. When the RWCU system was isolated, the leakage stopped and steam

stopped coming from the in-plant drain funnels. These events indicated that the relief valves on the RWCU regenerative heat exchangers were the source of steam into the SDV and the RBEDT drains.

C. CAUSE OF THE EVENT:

The root causes of the scram are (1) less than adequate procedural guidance, given the current RWCU system design, concerning returning the RWCU system to service, (NRC cause code [D] defective procedure) and (2) the actuation of the Flow Control Incorporated (FCI) level sensing devices for the SDV in response to steam rather than actual water level in the SDV (NRC cause code [X] other).

Given the current design of the RWCU system, the procedure did not provide appropriate guidance for repressurizing the system. As a

result, when the RWCU system was returned to operation, the RWCU regenerative heat exchanger relief valves lifted. The relief valves are not designed to ensure re-closure above RWCU system pressure. Therefore, the relief valves remained open and discharged to the RBEDT. The hot water (approximately 450 degrees F) flashed to steam in the piping to the RBEDT. Operations personnel were initially unaware that the relief valves were open. Consequently, the steam eventually flowed into the connecting piping, which put steam into the south scram discharge volume (SDV "B"). The steam in the SDV caused the FCI level sensing devices to trip, which caused the scram.

The FCI instrument is a thermal sensor that reacts to changes in the thermal conductivity of its environment. The thermal conductivity of water is much higher than that of air. The sensitivity of the FCI instrument is adjustable. The FCI devices had been adjusted in response to a similar event at Dresden Nuclear Power Station involving FCI actuation in response to the presence of steam. The manufacturer provided guidance concerning adjusting the sensitivity of the instruments. The adjustment was recommended to provide more margin to a false actuation from the presence of steam. The manufacturer recommended the sensitivity be decreased by a particular amount, providing increased margin to a false actuation, but still allowing the instruments to sense actual level and respond as designed. The sensitivity setpoint chosen by Quad Cities was conservative with

respect to manufacturer recommendations. The setpoint chosen provided greater assurance that the instruments would sense actual level than there would have been with the manufacturer's recommendation. Although the margin to an invalid actuation when in a steam environment was improved from prior to the change being made, the improvement was not equivalent to what would have been provided by the manufacturer's recommendation.

The root cause of the auto-start of the EDG is less than adequate design of the auto-start logic (NRC cause code [B] Design). The short time gap that the feed breakers from T11 and T12 are open results in a signal to the auto-start logic. The feed breaker open gap is typically of such a short duration that the start signal does not seal in. However, in response to this event the logic did seal in and the EDG auto-started.

D. SAFETY ANALYSIS:

The reactor scram and subsequent EDG start events were not safety significant. The Reactor Protection System tripped as designed when a signal indicating high level in the SDV was received. Although this level signal was a false high level signal resulting from steam flowing past the FCI level switches due to a pressure transient event in the RWCU system, the plant responded as designed. There were no safety system functional failures associated with this event.

There was no water level in the SDV until the control rods scrammed. Due to the design of the sensors, the steam that came from the RWCU system through the RBEDT caused the SDV high level sensors to sense a false high level. The level in the SDV was not high and did not inhibit Control Rod Drive actuation during the scram.

The EDG auto-started in response to breaker position in the circuit between off-site power and the emergency bus. The emergency bus did not reach an undervoltage setpoint, and the transfer of off-site power occurred as designed. The EDG conservatively responded to the extremely short time period when both feed breakers were open by auto-starting. The EDG was,operable and available at all times.

E. CORRECTIVE ACTIONS:

Corrective Actions Completed:

QCOP 1200-11, "RWCU System Startup and Pump Operation," was revised to require filling and venting the RWCU system, except when required to aid in level control, following system shutdown/isolation. QCOP 1200-01, "RWCU System Fill and Vent," was revised to reduce the likelihood of introducing a water hammer event during system pressurization by using a manual valve to fill the system to allow finer control. These changes also require in-plant operator monitoring of the RWCU system to listen for abnormal noises and monitor the thermocouples (reference corrective action below) on the relief valve lines. Also, the applicable annunciator procedures were revised to include a discussion

of the fact that steam from systems like RWCU can cause SDV level switch actuations.

Additionally, magnetic thermocouples were installed on the outlet piping of relief valves 1-1299-79, 1-1299-80, and 1-1201-60A/B. This action was completed on May 22, 1999. Procedures were revised to include the use of the thermocouples to assist in determining if a relief valve is leaking during system filling and venting or upon system start-up. The thermocouples provide the ability to determine relief valve flow without entering the RWCU heat exchanger room, thus reducing personnel dose.

Corrective Actions to be Completed:

1. Adjustment of the sensitivity setpoint for the FCI instruments will be reviewed for the potential to provide slightly more margin to a false actuation due to steam. If appropriate, the sensitivity setpoint will be subsequently adjusted. Action Tracking Item #11612, Assignment #14. Due date of July 30, 1999 (for review of the need and appropriateness of adjusting the setpoint).

2. The design of the RWCU system will be reviewed for improvements that will decrease the likelihood of opening the relief valves. This review will include the need to add a "thermal expansion loop" on Unit 1 relief valve 1-1299-79 similar to the Unit 2

configuration, and the potential for replacing the relief valves with valves that reseat at or above nominal system pressure. Action Tracking Item #11612, Assignment # 15. Due date of July 30, 1999.

3. Installation of a time delay to the auto-start relay for Bus 14 breaker open logic. Action Tracking Item #11635, Assignment #8. Due date of October 27, 2000.

F. PREVIOUS OCCURRENCES:

Although not reportable, during a recent event at Quad Cities on March 14, 1999, the RWCU relief valves (1-1299-79 and / or 1-1299-80) opened during RWCU fill and vent operations, causing some reactor building contamination. Following this event, the relief valves leaked as evidenced by increasing level in the RBEDT. Therefore, the relief valves were replaced with bench-tested spares during a subsequent outage.

G. COMPONENT FAILURE DATA:

There were no component failures associated with this event.

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